Sulfur Isotopic Signatures of Basalts and Associated Springs in SE Oregon, USA

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Warner Valley is a closed-drainage basin located in the semi-arid, high-desert plateau of south-eastern Oregon. Approximately 700 m of extensionally faulted Tertiary continental flood basalts and andesites (part of the Columbia River Group) are exposed on Warner Valley's eastern boundary. Hypersaline, alkaline lakes extend N-S for 65 Km on the valley's floor. Association of mantle derived rocks with evaporative lakes and playas within Warner Valley constitute an intriguing analogue for basalt-hosted paleolakes on Mars. Basalts and spring waters were sampled and analyzed for S isotopic composition ($\delta^{34}S$) in order to identify geochemical processes driving S-cycling in a non-marine semi-arid setting. Warner Valley basalts contain 10 to 1980 ppm total S with whole rock $\delta^{34}S$ of 5.2 to 9.7 $^{o}/_{oo}$ (n=11; avg.=8.1 $^{o}/_{oo}$). Sulfur species in basalt samples were isolated and purified following a sequential chemical extraction protocol. Values of $\delta^{34}S$ for monosulfides (pyrrhotite) range from 1.5 to 5.9 (n=5; avg.=4.4 $^{o}/_{oo}$); disulfides (pyrite) range from -0.8 to 13.5$^{o}/_{oo}$ (n=13; avg.=6.0 $^{o}/_{oo}$), and sulfates (barite) range from 3.1 to 9.5 $^{o}/_{oo}$ (n=24; avg.=7.4 $^{o}/_{oo}$). Values of $\delta^{34}S$ for extraction residues range from 8.4 to 9.7 $^{o}/_{oo}$ (n=19; avg.=8.9 $^{o}/_{oo}$). Cold springs $\delta^{34}S$ are 7.5 to 10.8 $^{o}/_{oo}$ (n=12; avg.=9.0 $^{o}/_{oo}$) and hot springs $\delta^{34}S$ are 7.9 to 9.5 $^{o}/_{oo}$ (n=6; avg.=8.6 $^{o}/_{oo}$) for hot spring samples. Sulfate in spring waters and basalt-barite have similar $\delta^{34}S$ values, suggesting pervasive hydrothermal alteration of basaltic bedrock.